

Atomic Structure: JournalNAME: hutchCLASS: physical scienceDATE: 3/8/2012**FOCUS QUESTION: What is the structure of an atom of sodium-23?****TAB 1: Particles and Arrangement**

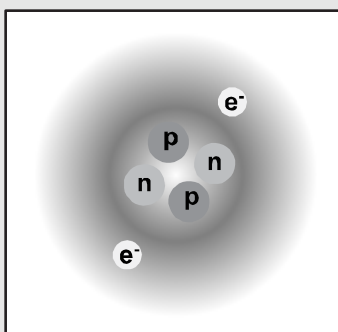
Read the questions below. Then complete this Journal by interacting with the online Simulation.

Remember: the Journal does NOT check your answers. Review your text entries and make sure you've transferred data to the correct table row(s).



Atoms are composed of protons, electrons, and, usually, neutrons. Protons and neutrons have virtually identical masses; in comparison, the mass of an electron is negligible. The protons (which are positive) and neutrons (which are neutral) are in the nucleus of the atom; thus, this small yet massive center is positively charged.

The negatively charged electrons move in an area outside the nucleus called the electron cloud. This cloud represents the region where an electron is most likely to be found.

**Numbers of Particles**

In this section, you will learn how to use the periodic table to determine the numbers of protons, neutrons, and electrons the atoms of a particular element possess.



In the Simulation (to the right) click on an element to view its atomic number and mass. Use the sliders to indicate the numbers of protons, neutrons, and electrons the element has. Build an atom by dragging the nucleus and electrons to their correct locations.

When you click on an element, you will see the information typically found in a block of the periodic table—the element's symbol, its atomic number, and its atomic mass:

19	atomic number
El	
22.3456	atomic mass

1.1 Data Collection

- Click (in the Simulation) to select Ar (argon) and Al (aluminum).
- Record their atomic numbers below.
- To see how many protons each element has, press the Equals button.

Table 1: Atomic Numbers			
element	atomic #	=	protons

Ar	18	=	18
Al	13	=	13

- 1.2 What is the relationship between the atomic number of an element and the number of protons an atom of the element possesses?

they are the same

1.3 Data Collection

- Click (in the Simulation) to select argon and aluminum.
- Record their atomic masses below.
- To see the mass number for each element, press the Equals button.
- To see how many neutrons each element has, press the Equals button.

Table 2: Atomic Masses						
element	atomic #	atomic mass	=	mass #	=	neutrons
Ar	18	39.948	=	40	=	22
Al	13	26.982	=	27	=	14

- 1.4 What is the relationship between atomic mass and mass number?

Mass number is the rounded of atomic mass

- 1.5 Write an equation that shows how to find the number of neutrons, given the atomic number and mass number.

mass number - atomic number

- 1.6 Atoms have no overall charge. Since atoms are electrically neutral, what is the relationship between the numbers of protons and electrons they possess?

Protons and electrons equal each other out

- 1.7 How many electrons does an atom of argon possess? an atom of aluminum?

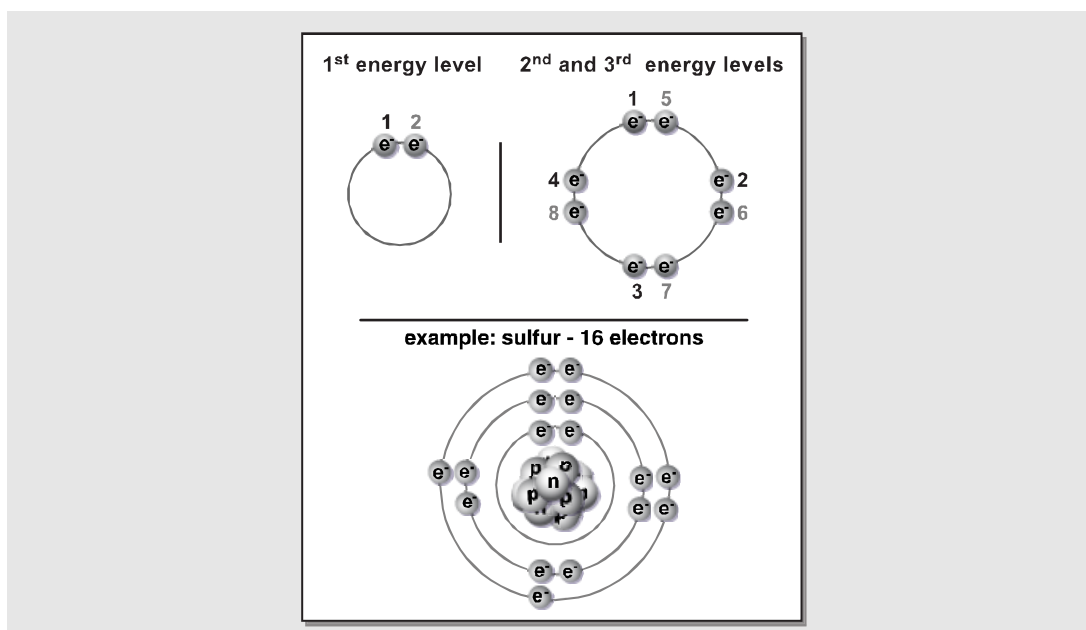
Argon=19
Aluminum=13

Arrangement of Particles



In the Bohr (or planetary) model of atomic structure, energy levels are represented by circular orbits. The first energy level can hold two electrons, the second energy level can hold eight electrons, and the third energy level can hold 18 electrons. Electrons occupy lower energy levels (those closest to the nucleus) before filling in higher energy levels.

Electrons are usually placed in the energy levels as follows (numbers indicate the order of placement for electrons 1-18):



In this section, you will represent the electronic structure of an atom with the Bohr model.

1.8 Data Collection

For each element in Table 3 (below):

- Click to select the element in the Simulation.
- Use the sliders to enter the numbers of protons, neutrons, and electrons it possesses.
- Build an atom by dragging the nucleus and electrons to their correct locations. Remember to place the electrons as indicated above.


After building an atom, use the Transfer Data button () to transfer the nucleus and energy-level data from the Data panel to the table. Then, use the pull-down menu to select the mass number.

Table 3: Atomic Structures						
element	nucleus		energy levels			mass #
	protons	neutrons	1 st	2 nd	3 rd	
<div>18</div> <div>Ar</div> <div>39.948</div>	18	22	2	8	8	40
<div>13</div> <div>Al</div> <div>26.982</div>	13	14	2	4	7	27
<div>3</div> <div>Li</div> <div>6.941</div>	3	3	1	1	1	6
<div>10</div> <div>Ne</div> <div>20.180</div>	10	10	3	3	4	20

7 N 14.007	7	7	2	2	3	14
5 B 10.811	5	6	1	3	2	11
15 P 30.974	15	16	6	5	5	31
9 F 18.998	9	10	4	3	3	19
2 He 4.003	2	4	2	0	0	4
4 Be 9.012	4	5	1	1	2	9

TAB 2: Isotopes



John Dalton said all atoms of the same element are identical, which isn't entirely correct. All atoms of the same element do possess the same number of protons, but they can have differing numbers of neutrons. For example, hydrogen has three different isotopes, each of which possesses one proton, but zero, one, or two neutrons.

When using the periodic table to determine mass number for an element, you are actually finding the mass number for the most abundant isotope of that element. How can you determine the numbers of neutrons in additional, less abundant isotopes of an element?

In this section, you will learn how to determine the numbers of protons, neutrons, and electrons any isotope possesses.



In the Simulation (to the right) click on an element to view its common isotopes. Select an isotope and use the sliders to indicate the numbers of protons, neutrons, and electrons it has. Build an atom by dragging the nucleus and electrons to their correct locations.

- 2.1** Click on Mg (magnesium). Compare its isotope symbols to the information in the table below. What does the top number in an isotope symbol represent?

Table 1: Isotope Symbols		
isotope symbol	atomic #	atomic mass

$^{24}_{12}\text{Mg}$	12	23.985
$^{26}_{12}\text{Mg}$	12	25.982

2.2 What does the bottom number in an isotope symbol represent?

2.3 Click on Cl (chlorine). Compare its isotope symbols to the information in the table below. What does the number in an isotope symbol such as chlorine-37 represent?

Table 2: More Isotope Symbols		
isotope symbol	atomic #	atomic mass
chlorine-37	17	36.966
chlorine-35	17	34.969

2.4 Data Collection

For each element in the tables below:


- Click to select the element in the Simulation.
- Click to select each isotope.
- Use the sliders to enter the numbers of protons, neutrons, and electrons the isotope possesses.
- Build an atom by dragging the nucleus and electrons to their correct locations.
- Use the Transfer Data button () to transfer the nucleus and energy-level data from the Data panel to the table.

Table 3: Isotope Structures					
isotope symbol	nucleus		energy levels		
	protons	neutrons	1 st	2 nd	3 rd
$^{12}_6\text{C}$					
$^{14}_6\text{C}$					
$^{36}_{16}\text{S}$					
$^{32}_{16}\text{S}$					

Table 4: Additional Isotope Structures						
isotope symbol	atomic #	nucleus		energy levels		
		protons	neutrons	1 st	2 nd	3 rd
hydrogen-3	1					
hydrogen-2	1					
oxygen-16	8					
oxygen-18	8					

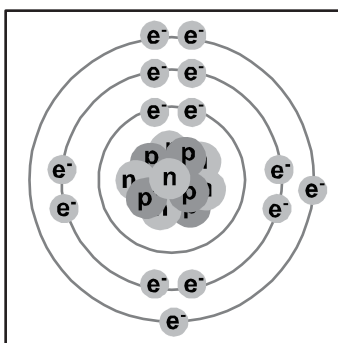
Atomic Structure: AnalysisNAME: hutchCLASS: physical scienceDATE: 3/8/2012**TAB 3: Analysis**Refer to the Journal **and a periodic table**, as needed, to answer the following questions.**Particles**

- A.1** Fill in the following table to demonstrate your understanding of the relationships among atomic number, mass number, and numbers of subatomic particles. Note: for an element whose mass number is not specified, find the numbers of particles in its most abundant isotope.

Analysis Table 1					
element	atomic #	mass #	protons	neutrons	electrons
Sn (tin)					
			30		
	56				
Pt (platinum)					
					31

Arrangement and Isotopes

- A.2** Examine the following Bohr model. Assuming it represents the most common isotope of a particular element, identify the element and indicate the numbers of protons, neutrons, and electrons it possesses.



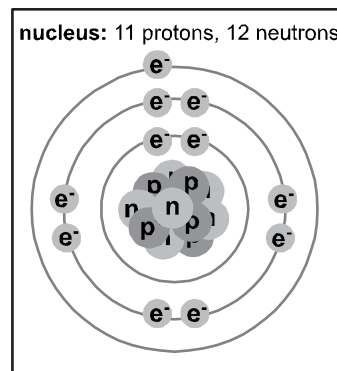
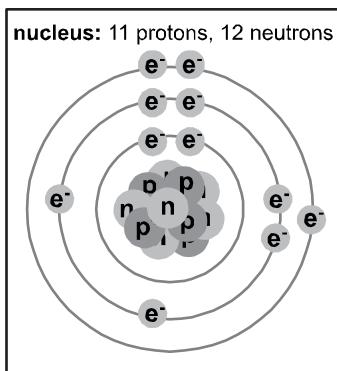
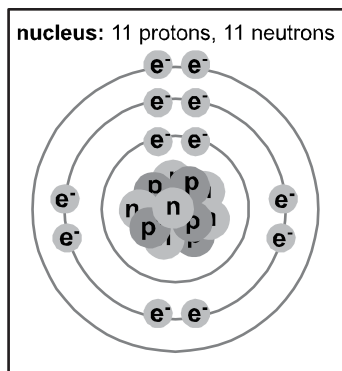
- A.3** Fill in the following table to demonstrate your understanding of the electronic structures of atoms.

Analysis Table 2					
isotope symbol	nucleus		energy levels		
	protons	neutrons	1 st	2 nd	3 rd
sulfur-34					
$^{42}_{20}\text{Ca}$					

$^{59}_{28}\text{Ni}$					
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Conclusion

A.4 Focus Question—What is the structure of an atom of sodium-23? First, click to select the image below that correctly represents the structure of sodium-23:



Then, explain how you can determine the numbers of particles in an atom, how many protons, neutrons, and electrons sodium-23 possesses, and how these particles are arranged (according to the Bohr model).